CHAPTER 11 INCREASING ENERGY EFFICIENCY IN HAWAII'S BUILDINGS

11.1 Energy Efficiency and Buildings

Most of Hawaii's electricity, utility gas, and non-transportation uses of fuel are used to provide lighting, heating, ventilation, air conditioning, water heating, drying, cooking, and other end-uses in buildings. This chapter examines ways to reduce energy demand in Hawaii's buildings and how energy efficiency can be increased. These goals involve a variety of energy efficiency programs in Hawaii, that are carried out by federal, State, and local governments, the utilities, and public-private partnerships such as the Rebuild America Program.

Increased energy efficiency reduces the need for imported fossil fuels, reduces the negative economic and environmental effects of energy use, and can contribute to deferring the construction of new electricity generation units. For energy users, energy costs can be significantly reduced.

11.2 Current Energy Efficiency Measures in Hawaii's Buildings

11.2.1 The Model Energy Code

11.2.1.1 Development of the Hawaii Model Energy Code

The Hawaii Model Energy Code was based on American Society of Heating, Refrigerating, and Air Conditioning Engineers (ASHRAE) Standard 90.1-1989; ASHRAE 90.2P, California's Title 24; and the USDOE standard for non-residential buildings. It was modified to make the code more appropriate to Hawaii's climate (DBEDT 1993b, 5). The code sets minimum requirements for the energy-efficient design of new buildings, provides criteria for energy-efficient design, and provides methods for determining compliance with these criteria (DBEDT 1993a, 1). It sets standards for electric power; lighting; building envelope; heating, ventilating, and air conditioning systems and equipment; water heating systems and equipment; and energy management.

11.2.1.2 Adoption of the Model Energy Code

In 1994, the State Legislature passed Act 168, which required the counties to adopt an energy code based on ASHRAE 90.1 by October 24, 1994. The Model Energy Code meets this requirement. All counties except Maui County have adopted the code. Honolulu and Kauai counties exempted low-rise residential buildings; Hawaii County exempted single-family dwellings and duplexes.

When adopted by all of the counties, the Model Energy Code will also bring Hawaii into compliance with the federal Energy Policy Act of 1992 (EPACT). EPACT required each state to certify by October 24, 1994 whether the state had met or exceeded the requirements of ASHRAE 90.1 for commercial buildings and whether the state had determined the appropriateness of meeting or exceeding the

national Model Energy Code for residences. Hawaii's Model Energy Code has been determined to meet EPACT requirements. (DBEDT 1993b).

11.2.1.3 Impact of the Model Energy Code

All measures included in the Code are cost-effective. An *Impact Analysis of the Model Energy Code*, published in December 1993, predicted annual energy cost savings in Hawaii of about $1.086 million per year, at a one-time compliance cost of $1.649 million (DBEDT 1993b). Thus, the cost of implementing provisions of the Code was expected to be paid back by savings in about 1½ years. Annual peak demand reduction was expected to be 2.82 MW, and with about 11GWh per year were saved, and a reduction of CO_2 emissions by 11,300 tons. Table A.30, in Appendix A, shows the cumulative energy and cost savings forecast in the original impact study, and an estimate of CO_2 emissions reduction.

11.2.1.4 RECOMMENDATION: Adopt Model Energy Code for Maui County (Currently Under Consideration) and Adopt Residential Building Model Energy Code in All Counties

Suggested Lead Organizations: The Counties

The County of Maui is currently considering the MEC and is encouraged to adopt it. Since air conditioning appears to be a growing end-use for residential buildings in Hawaii, DBEDT encourages the counties to favorably reconsider adoption of the residential building portions of the original Model Energy Code or to adapt them further to their requirements.

11.2.1.5 RECOMMENDATION: Encourage Continued Use of HiLight Software Program by Lighting Designers to Ensure Model Energy Code Compliance

Suggested Lead Organization: The Building Industry and Design Professionals

HiLight is a software program developed for DBEDT in 1996 by Eley Associates on a cost-shared basis with the U.S. Department of Energy. The program is available at no charge on the Internet at http://www.state.hi.us/dbedt/ert/mec /app-b.html or http://www.eley.com. The software helps the lighting designer evaluate and document the lighting performance of new commercial buildings. It also allows plan checkers to quickly check plans for conformance with the Code.

11.2.1.6 RECOMMENDATION: Continue to Evaluate Impact of and Improve the Rate of Compliance with the Model Energy Code

Suggested Lead Organizations: DBEDT and the Counties

The *MEC Compliance Report* involved a detailed analysis of 21 building plans for buildings completed in the 1994–1997 period in Honolulu County and 11 building plans in Hawaii County (Eley 1999, 1). The report indicated that the original

savings estimates made in the *1992 Impact Analysis* would have been on target if all counties had adopted the MEC (1). If 100% compliance were achieved, about $1.1 million would be saved yearly, resulting in a cumulative savings of $222 million in 20 years. The report showed an 87% rate of compliance in Honolulu and Hawaii counties. Thus about $160,000 in potential savings was lost due to non-compliance. The report includes recommendations for improving the rate of compliance (Eley 1999).

11.2.2 Utility Demand-Side Management Programs

DSM is defined as any utility activity aimed at modifying the customer's use of energy to reduce demand. It includes conservation, load management, and efficiency programs. DSM offers the potential for lower customer utility bills, deferral of major power plant investments, reduced environmental impacts, and potential diversification of resources (NEOS 1995, ES-1).

The four electric utilities each proposed DSM programs as part of their initial Integrated Resource Plans (IRPs) and filed their programs for Public Utility Commission approval and determination of cost recovery. Kauai Electric (KE), HECO, and HELCO filed their DSM programs in their second round IRPs.

11.2.2.1 HECO Demand-Side Management Plan

HECO's objectives for DSM, as stated in their second IRP, were to:

- Acquire cost-effective energy efficiency and peak reduction measures that were less expensive than supply alternatives;
- Enhance customer value by providing energy services not previously offered by the company; and
- Promote technologies which are environmentally sensitive and minimize environmental damage to Hawaii's unique ecosystem (HECO 1998b, 12-1).

As part of HECO's first IRP, the company filed a DSM Action Plan with the Commission on January 18, 1994. The plan included the following programs, which were approved by the Commission in 1996:

- **Commercial and Industrial Energy Efficiency Program** – promotes more efficient air conditioning, lighting, refrigeration, and motors (7-14).
- **Commercial and Industrial New Construction Program** – provides design and technical assistance for more efficient air conditioning, lighting, motors, and other end uses (7-19).
- **Commercial and Industrial Customized Rebate Program** – provides for cost-sharing arrangements to fund customer-proposed energy efficiency opportunities (7-23).

- **Residential Efficient Water Heating Program** – promotes the use of high-efficiency water heating technologies such as solar water heating, heat-pump water heaters, and high-efficiency resistance water heaters (7-10).
- **Residential Efficient Water Heating Program (New Construction)** – promotes solar water heating, heat-pump water heaters, and high-efficiency resistance water heating to developers of new housing (7-6).

HECO estimated that 9,279 GWh of electricity would be saved through its DSM programs over the 20-year plan period. This would reduce CO_2 emissions by 9,094 million tons. Annual emissions savings would reach 761,323 tons of CO_2 in 2017. Table A.31, in Appendix A, details the projected energy and emissions reductions.

In its second IRP, HECO reviewed the *Hawaii Demand-Side Management Opportunity Report*, produced by DBEDT as part of *HES 1995*. HECO elected to maintain and further develop the five DSM programs established in their first IRP and to add two load management programs (7-2). The two load management programs were:

- **Commercial and Industrial Capacity Buy-Back Program** – to provide 30 MW of interruptible load beyond that provided by existing customers under Rider I rates (7-36).
- **Residential Water Heating Direct Load Control Program** – to provide customers with a $2.50 monthly incentive to allow HECO to install a radio-controlled switch on their water heaters to allow them to be shut off in emergencies and to defer capacity additions (7-39).

The two load management programs are intended to defer the need for new capacity by reducing peak demand, a strategy known as "peak shaving." The five original DSM programs also offer some peak demand savings. Estimated peak demand savings for each program are shown on Table A.32. The 167.58 MW expected to be deferred during the period covered by HECO's IRP-97 (to 2017) can be compared in size with the planned 107 MW combustion turbine (CT) or the 180 MW atmospheric fluidized bed coal plant planned for installation late in the planning period.

11.2.2.2 HELCO Demand-Side Management Plan

HELCO set the same objectives for its DSM programs in IRP-98 as HECO (HELCO 1998b, 9-1). HELCO developed four DSM programs in its first IRP, which were approved by the PUC in December 1995. They included a Commercial and Industrial Energy Efficiency Program, Commercial and Industrial New Construction Program, Commercial and Industrial Custom Rebate Program, and Residential Efficient Water Heating Program. HELCO combined its new construction and existing customer residential efficient water heating programs into a single program. In addition, HELCO distributed high efficiency

shower heads to customers. These reduce hot water use, and thereby, water-heating and water-pumping loads.

By 2018, the HELCO DSM programs were estimated to reduce annual Big Island energy requirements by 103.96 GWh, reducing CO_2 emissions in that year by 102,401 tons. Over the 20-year period of the plan, energy savings were estimated to be 1,024 GWh and the CO_2 emissions reduction was forecast to be 1.111 million tons. Table A.33 details the estimated energy savings and CO_2 emissions reductions for HELCO DSM programs. Table A.34 summarizes the estimated peak demand savings from HELCO DSM programs. The 15 MW peak demand savings estimated by 2018 represents partial deferral of a nominal 20 MW CT unit.

HELCO also received approval of a pilot Capacity Buy-Back DSM Program on March 24, 1997. However, HELCO decided not to implement the program due to positive customer response to its existing load management rates and rate riders, which give incentives to customers to curtail load during system peak periods. HECO had 28 contracts representing about 6.7 MW of peak-shaving capacity when the IRP was completed in September 1998. HELCO assumes curtailment of 5.5 MW for planning (ES-6).

11.2.2.3 KE Demand-Side Management Plan

Kauai Electric developed six DSM programs in its first IRP in 1993. They were incorporated into the 1994 DSM Action Plan (KE 1997b, D-7), approved by the Commission in August 1997. A new plan was developed as part of KE's 1997 IRP, filed on April 1, 1997. It included the following five programs:

- **Commercial Retrofit Program** – promotes energy efficiency improvements to existing commercial buildings through energy audits, customer education, and monetary incentives for measures installed (D-12).
- **Commercial New Construction Program** – provides education, technical assistance, and incentives to commercial new construction owners and trade allies to promote the use of energy-efficient equipment in building design (D-22).
- **Residential Retrofit Program** – involves a combination of trade allies, energy efficiency education, and incentives to encourage customers to adopt energy-efficient lighting and other low-cost measures, and to retrofit their homes with such technologies as heat-pump or solar water heaters, and hard-wired fluorescent fixtures (D-26).
- **Residential Direct Install Program** – provides efficient lighting and water heating measures to the low-income and renter markets. It includes a separate focus on State of Hawaii Housing Authority units (D-33).
- **Residential New Construction Program** – provides energy efficiency technical assistance to residential builders and trade allies. Incentives and financing will be provided to encourage inclusion of solar water heaters,

heat-pump water heaters, and hard-wired fluorescent fixtures in new units (D-39).

The programs are expected to reduce energy use over the 20-year period by 558 MWh and save about 390,500 tons of CO_2 emissions. Table A.35 depicts the estimated energy savings and reduction of greenhouse gas emissions from KE's programs. KE expects the estimated peak demand savings for DSM programs to be maximized in 2005, at 5.78 MW as presented on Table A.36.

11.2.2.4 MECO Demand-Side Management Plan

On June 2, 1995, MECO filed applications with the PUC for its DSM programs. The MECO programs were essentially the same as HECO's, but the residential efficient water heating programs for existing and new customers were combined (13-15). The programs were approved in 1996 (MECO 1997b, 11).

MECO projected energy savings of 936 GWh over the 20-year period, which would result in a DBEDT-estimated CO_2 emissions reduction of 880,169 tons. MECO reduced its estimate of the energy and capacity savings from its DSM programs as a result of the experience of HECO and HELCO. It should be noted that, while the County of Maui has not yet adopted the Hawaii Model Energy Code, such adoption could reduce the impact of MECO DSM programs. Table A.37 summarizes the projected energy savings and CO_2 emissions reductions. Table A.38, in Appendix A, shows estimated peak demand reductions from MECO DSM programs.

11.2.2.5 RECOMMENDATION: Continue to Support Cost-Effective Utility Demand-Side Management Programs through Partnership Programs and Participation in IRP Planning Activities

Suggested Lead Organizations: The Utilities, DBEDT, and Counties

The utility DSM programs outlined above contribute significantly to energy efficiency and reduction of the need for electricity generation. They should be strongly supported. DBEDT will continue its partnerships in several programs and will continue to participate in utility DSM Advisory Groups as part of the IRP process

11.2.3 State Government Efficiency Programs

This section outlines a number of energy efficiency programs that reduce the need for electricity generation and reduce electricity demand. Hawaii government programs identify, initiate, and implement energy and resource efficiency programs through public-private sector partnerships and through existing resources and competitive grants awarded from federal agencies.

Specific programs include residential and commercial building efficiency; alternative financing; Rebuild Hawaii; voluntary energy efficiency guidelines on appropriate methods, technologies, and appliances for single family residential dwellings; guidelines for energy efficiency in commercial buildings, and building

commissioning. These programs are supported by specialized technical assistance and training to transform the market for energy and resource efficiency technologies. A major initiative is to develop private/public sector partnerships that use energy and resource efficiency as a catalyst for sustainable development.

11.2.3.1 RECOMMENDATION: Increase State Government Efforts to Improve Energy Efficiency by Meeting State Goals for Reduction of Energy Use in State Facilities

Suggested Lead Organizations: DBEDT and State Agencies

Administrative Directive No. 94-06 established an Energy Management and Efficiency Program for State Facilities to moderate the growth in energy demand through conservation and energy efficiency (Waihee 1994). Governor Cayetano endorsed the Directive through *Executive Memorandum No. 96-01, Subject Fiscal and Energy Management* on January 22, 1996 (Cayetano 1996). Governor Cayetano urged all departments and agencies to use public funds judiciously by making energy efficiency a priority.

11.2.3.2 RECOMMENDATION: Continue Transfer of Advanced Building Technologies and Development of Design Guidelines

Suggested Lead Organizations: DBEDT, the Utilities, Design Professionals, and the Building Industry

Under grants from the U.S. Department of Energy (USDOE), DBEDT ERT Division has contracted with several organizations in Hawaii to provide educational and informational materials, develop public-private partnerships, and conduct professional development training in areas related to building energy efficiency. Recent activities included:

Hawaii Advanced Building Technologies Program. The University of Hawaii at Manoa School of Architecture developed a training program for the Hawaii residential construction industry to assist with the integration of energy- and resource-efficient design, building materials, and techniques in the design and construction of homes in Hawaii.

Residential Energy-Efficient Building Guidelines. The Honolulu Chapter of the American Institute of Architects was contracted to develop and implement voluntary residential building guidelines to support and extend the State's Model Energy Code. This project included training materials and training sessions and the planning and building of at least one model demonstration house.

Commercial Building Efficiency Guidelines. Participants in the project will work toward the development of the next-generation building code for new and renovated commercial developments and buildings. HECO will provide matching funds to supplement the USDOE grant and will also offer its Energy Awards Program, technical assistance, and marketing programs to promote and support the project.

Demonstration Project in Building Commissioning. Based on a recommendation from the April 1999 Workshop on Energy Efficiency in Federal Facilities, DBEDT will work with the Department of Accounting and General Services to implement a demonstration commissioning project.

11.2.3.3 RECOMMENDATION: Expand Hawaii State Government Energy Performance Contracting and Alternative Financing for Energy Efficiency Projects

Suggested Lead Organizations: DBEDT, State Agencies, Financing Companies

Performance contracting is an arrangement in which a private company, called an energy service company, or ESCO, finances and installs energy-efficiency-related equipment and building improvements for a payment that depends on future energy savings resulting from the improvements. There are several features that distinguish energy performance contracting:

- A single procurement is used to purchase a complete package of services and one contractor is accountable for design, purchase, installation, maintenance, and operation of the equipment;
- The package of services includes financing of all of the project costs. No up-front money is needed by the building owner to implement a performance contract;
- The performance contract is structured so that the total payments *with* the contract are always less than the energy payments would have been *without*. This is because the annual energy savings produced by the project are greater than its amortized cost;
- State of the art, energy-efficient lighting, air-conditioning systems, energy management control systems, motor replacements, and variable-speed drives for pumps and fans are common improvements. In larger facilities, cogeneration units may be installed;
- Management and maintenance resources are included in the turnkey service; and
- The risk of energy savings performance is transferred to the ESCO, because payments are contingent on actual savings achieved, which are guaranteed by the ESCO.

DBEDT's ERT Division is coordinating a number of performance contracting efforts within Hawaii's state government. The ERT staff provides assistance to state agencies seeking to obtain the benefits of energy performance contracting under Section 36-41, Hawaii Revised Statutes. DBEDT ERT developed a *Guide to Energy Performance Contracting*, which is being used to stimulate performance contracting activities in other state organizations. Additional projects under development, if fully implemented, will save the state more than

$4 million annually in energy costs, leverage $23 million in private funds for energy improvements, bring in an estimated $11.5 million in income to the economy, and create 350 new jobs.

ERT is providing technical assistance to interested facility and agency managers throughout the performance contracting process, from developing the RFP through monitoring and verifying savings. The University of Hawaii at Manoa has signed an agreement with Hawaiian Electric Company, Inc., for a program to carry out energy efficiency retrofits on the Manoa campus. The Department of Education is proposing to implement energy efficiency in Maui schools through a lease purchase program.

Table A.39 shows the estimated results from performance contracting for the State projects now under development. It should be noted that part of the financing of these projects may come from utility DSM programs, so the energy and CO2 savings shown may be included in the DSM program savings cited above.

11.2.3.4 RECOMMENDATION: Continue to Support State Participation in Rebuild America and Other Public-Private Partnerships and Alliances to Improve Resource Efficiency

Suggested Lead Organizations: DBEDT, Hawaii Rebuild America Partnerships, Rebuild Hawaii Consortium, and Partner Organizations

The federal government has expertise, research capabilities, and access to energy efficiency technologies, but knowledge about specific resource-efficiency problems often exists at state or local levels. National governmental agencies are forging alliances with states and local governments to encourage resource efficiency. The USDOE's Rebuild America Program is an example of one such alliance. Other federal programs encouraging energy efficiency partnerships are the Million Solar Roofs Program, Energy $mart Schools Program, federal Energy Management Program, the Motor Challenge Program, and several EPA building efficiency programs. In 1999, DBEDT's Energy Branch was implementing more than $1.4 million in active competitive federal government grants, $313,000 of which was for the State's Rebuild America Program

Hawaii's Rebuild America Program. The State of Hawaii's Rebuild America Program focuses on stimulating the economy and achieving cost savings through the increased use of energy efficient technologies in the public and private sectors. The mission is to promote efficient resource utilization by: identifying and leveraging statewide resources, creating community awareness, building partnerships, and employing innovative solutions to resolve resource efficiency issues. There are ten Hawaii partners, including the four counties. The program is initially focusing on encouraging energy performance contracting to retrofit government buildings with energy efficient technologies. The program also includes public sector multi-family housing and small commercial programs. Potential energy, economic, and environmental benefits of existing Hawaii

Rebuild America Partnership Programs are detailed on Table A.40. Ongoing projects include:

- Performance contracts at the University of Hawaii at Hilo, the County of Hawaii, and the County of Kauai;
- A workshop and technical seminar on measurement and verification of energy savings in performance contracts;
- A small, commercial-sector energy efficiency market transformation project; and
- Support to Hawaii Rebuild America Partners.

Newly funded projects include:

- A community-sponsored rural energy project, the Na Makani Energy Initiative, in North Kohala, Hawaii, through which 100 low-cost solar water heating systems will be installed;
- Energy $mart Schools Project to train high-school students to be energy auditors, audit two public high schools, audit small businesses, and sustain energy efficiency education in schools and communities;
- Higher education projects, including an interdisciplinary team for a hotel efficiency project and "Greening the Campus" programs at the six Hawaii Community Colleges.

In August 1999, the State won the following U.S. Department of Energy national awards:

- **1999 Rebuild America State Representative of the Year Award** – Elizabeth Raman, DBEDT's Energy, Resources, and Technology Division, for individual performance in developing the Rebuild Hawaii Consortium.
- **1999 Rebuild America Award for Energy Excellence in State Government** – State of Hawaii for the DBEDT Rebuild Hawaii State Program.

These awards were for DBEDT's success in developing a statewide Rebuild America program and the Rebuild Hawaii Consortium, a network of community-based partnerships that empower Hawaii communities to save money, promote growth, create jobs, retain business, reduce energy waste, and protect the environment by investing in energy-efficient technologies.

11.2.3.5 RECOMMENDATION: Continue and Expand Energy Efficiency Technology Education and Training Programs

Suggested Lead Organization: DBEDT

Changing – or "transforming" – a market as an energy-efficiency policy option involves changing consumer preferences about their purchases of goods that use energy. Oftentimes, a problem with this approach is the higher up-front costs of

goods that are more energy-efficient. However, changing consumer demand for energy-efficient goods is expected to lower production costs and create economies of scale in manufacturing and distribution, leading to more affordable prices in Hawaii.

The State of Hawaii is very active in market transformation through its educational and training programs. DBEDT promotes renewable energy and energy efficiency through educational and promotional projects such as workshops and technical seminars, science and engineering fairs, exhibits, and energy-efficiency publications.

DBEDT has recently conducted workshops and technical seminars in each of the following areas: roof insulation, window tinting, management of construction and demolition waste, lighting efficiency, water and air conditioning design, motor efficiency, optimizing large pump systems, measurement and verification of energy savings, efficient electro-technologies (in partnership with HECO), building energy- and resource-efficient homes, building commissioning, and energy efficiency for federal facilities.

11.2.3.6 RECOMMENDATION: Continue Solid Waste Reduction and Recycling Programs

Suggested Lead Organization: DBEDT

With Hawaii's economic and population growth, and its ever diminishing landfill space, recycling activities in the state will become more critical in the future. DBEDT supports the Clean Hawaii Center (CHC) in its efforts to build on the current cooperative working arrangements it has established with federal, State, and County governments, as well as community organizations and the private sector, to support business development for the creation of jobs, increased capital investment and sales, reduced energy use, and reduced landfill requirements. Through a U.S. Environmental Protection Agency grant, the CHC is focusing on reducing construction and demolition debris that accounts for about 30% of landfill requirements. Although the CHC statutorily sunset on June 30, 1999, DBEDT has committed to continuing the mission of CHC.

11.2.4 County Government Energy Efficiency Programs

Hawaii's County governments are involved in a variety of energy efficiency programs, not only independently, but also in conjunction with the federal and State governments.

11.2.4.1 RECOMMENDATION: Continue and Expand County Government Energy Efficiency Programs

Suggested Lead Organizations: Counties, with DBEDT Support

County governments have programs and projects that contribute to reducing energy costs and improving Hawaii's economy, as well as reducing environmental pollution. Table A.41 summarizes estimated benefits in energy savings and CO_2 emissions reduction from County projects.

11.2.5 Federal Energy Efficiency Programs in Hawaii

11.2.5.1 Federal Government Electricity Use in Hawaii

The federal government is a major user of electricity in Hawaii. In particular, Hawaii's large military facilities, especially on Oahu, are major consumers of electricity. In 1996, military facilities used 16.4% of the electricity sold on Oahu (Chang 1997). To generate the electricity purchased by the Department of Defense in 1996, HECO emitted 1,218,880 tons of CO_2. It should be noted that, while overall electricity sales grew by 10.1% between 1990 and 1996, military use increased at a slower rate, 8.9%. Some force reductions may have slowed the growth of military electricity use, but the federal Energy Management Program was a likely additional factor.

11.2.5.2 Federal Energy Management Program

The mission of the federal Energy Management Program (FEMP) is to reduce the cost of government by advancing energy efficiency, water conservation, and the use of solar and other renewable energy. Section 543 of the National Energy Conservation Policy Act, as amended by the Energy Policy Act of 1992, required each federal agency achieve:

- 10% reduction in energy consumption in its federal buildings on a Btu per gross square foot basis by FY1995 against a FY1985 baseline; and
- 20% reduction in Btu per gross square foot by FY2000 (USDOE 1998b).

In addition, agencies are required to achieve a 30% reduction against the FY1985 baseline by FY2005, per Executive Order 12902 (USDOE 1998b). A key element of FEMP activities has been partnership with local electric utilities and demand-side management incentives offered by those utilities.

In his radio address to the nation on July 25, 1998, President Clinton took further action to decrease energy use in federal buildings and facilities to reduce greenhouse gas emissions and to save taxpayer dollars (Clinton 1998). More recently, the President issued Executive Order 13123 of June 3, 1999, entitled "Greening the Government Through Efficient Energy Management" (Clinton 1999). It set the following goals for federal agencies:

- Reduce greenhouse gas emissions by 30% by 2010 compared to 1990;
- Reduce energy use per gross square foot by 30% by 2005, and 35% by 2010 relative to 1985;
- Increase use of renewable energy
- Reduce use of petroleum and switch to less greenhouse gas intensive energy sources;
- Reduce total greenhouse gas emissions; and
- Conserve water (30851-30852).

Actions being taken by the federal government offer examples that can be imitated at the state and county levels, as well as by private business.

11.2.5.3 RECOMMENDATION: Continue Cooperative Efforts to Support Energy Efficiency Programs in Federal Facilities in Hawaii

Suggested Lead Organizations: Federal Agencies, Gas and Electric Utilities, DBEDT

DBEDT/Federal Energy Management Program (FEMP) joint project. In April 1999, Under a $40,000 grant from FEMP, DBEDT conducted a workshop on energy efficiency for federal facilities at which selected agencies presented case studies of their energy efficiency projects. A companion workshop on Building Commissioning was also held. As a follow-on to the workshop, DBEDT's consultant is assisting federal agencies to implement energy efficiency as follows:

National Weather Service. The National Weather Services has a potential application for PV/Fuel Cell hybrid systems at approximately 6–12 remote sites in Hawaii, Micronesia, Guam, and America Samoa. Technologies would include High-Efficiency Thin Film (HETF) Photovoltaics (PV) to run an electrolyzer that generates hydrogen for weather balloons and as a fuel source for Polymer Exchange Membrane (PEM) fuel cells. Oxygen is also generated and is used for multiple applications including water purification. DBEDT's consultant is assisting the agency to develop an integrated, modular, sustainable, renewable solution that can be used in a number of applications. There is a large potential export market for such technology, and the project is attracting potential strategic partners including PV and fuel cell manufacturers, and financiers.

Veteran's Administration. There is a potential for developing a delivery order under the Western Region's Super Energy Savings Performance Contract at the Veteran's Administration Site at Tripler Hospital. DBEDT's consultant is assessing technology applications for retrofit opportunities and will develop the delivery order if potential is found.

National Marine Fisheries Service, Honolulu Laboratory (NMFS). There is potential for design assistance for new construction and commissioning of a showcase facility. DBEDT's consultant is reviewing the design and status of the project with the NMFS staff to identify needs and will assist the agency to locate technical assistance and funding for the project.

U.S. Coast Guard. The U.S. Coast Guard in Hawaii has identified a number of energy efficiency opportunities, but projects involving additional third party financing have been put on hold.

U.S. Air Force. The Air Force is interested in expanding the current scope of its Energy Savings Performance Contract, and DBEDT's consultant is assisting them to identify additional energy savings opportunities.

Other federal Projects:

Federal Civilian Energy Efficiency Projects. In 1997, renovation of the air conditioning system of the Prince Jonah Kuhio Kalanianaole Building, also known as the Federal Building, was completed. It provided new, more efficient chillers, cooling towers with two-speed, energy-efficient motors, and an energy-efficient pumping system – all integrated into a computerized energy management system (GSA 1997). The new system resulted in nearly a 16% reduction in building energy use. The $4 million project earned more than $170,000 in rebates (Munger 1999a, 22-23) and reduced greenhouse gas emissions.

Air Force Energy Efficiency Projects. Air Force energy efficiency projects include installation of efficient lighting and occupancy sensors in base industrial facilities. In addition, as part of the renovation of Hickam Air Force Base family housing, heat recovery systems on central air conditioning units will provide hot water. Opportunities for solar water heating are limited at Hickam, as trees shade most housing areas. An energy services performance contract was recently issued for improvements to the Pacific Air Force Headquarters Building, the largest building on base. It is currently in the design stage (Young 1998).

Other Air Force projects earned more than $75,000 in utility rebates through installation of high-efficiency lighting in the new base exchange and high-efficiency air conditioning, compact fluorescent lamps, and T8 lighting in new family housing units (Munger 1999a, 23).

Army Energy Efficiency Projects. The Army achieved major reductions in energy use through a variety of energy awareness and energy efficiency programs. A relamping contract, developed using FEMP funding, retrofitted over 100 buildings with T8 fluorescent bulbs with electronic ballast, compact fluorescent bulbs, and LED exit signs. A recycling program was developed to recycle the old fluorescent light tubes, which contain hazardous materials. The longer lifetimes of the new lighting will reduce future maintenance and disposal costs. The lower heat gain from the new lights also reduced air conditioning costs (USAG-HI 1997).

In addition, over 1,950 heat-pump water heaters were installed in Army family housing. These units, plus high-efficiency office lighting and barracks air conditioning, have earned the Army more than $1.04 million in utility rebates (Munger 1999a, 23).

Marine Corps Energy Efficiency Projects. The Energy Management Team at Marine Corps Base Hawaii developed a 25-year performance contract that will implement up to $24 million in energy savings. The objective is to significantly reduce the $8 million annual energy bill for the base and its $9 million maintenance and repair costs. The initial projects were to install high-efficiency lighting fixtures in four buildings (FEMP 1997). Through revitalization of hundreds of family housing units, the Marine Corps received more than $220,000 in utility rebates. Measures used included 237 efficient water heating tanks and timers, high-efficiency air conditioners, compact fluorescent lamps, and T8 fluorescent lighting (Munger 1995a, 23).

Navy Energy Efficiency Projects. The Navy is involved in a major energy efficiency program for implementation under a basic ordering agreement (BOA) with HECO at a number of Navy-operated facilities on Oahu. The BOA is similar to a performance contract except that upon completion of construction, the customer accepts ownership of the equipment and operation and maintenance (O&M) responsibilities. Under a performance contract, the contractor retains ownership and handles O&M for the life of the contract. Also, results under the BOA are not guaranteed, but were developed by an engineering estimate.

At this time, the Pacific Division, Naval Facilities Engineering Command is administering the contracts for the Navy. Any DoD component can use the BOA to get energy efficient equipment installed at their installation. The current Navy program is estimated to cost $24.9 million and will result in annual savings of 29 million kWh and about 29,000 tons of CO_2. The energy savings will reduce the Navy's electricity bill by about $3.4 million per year and will earn a rebate from HECO's DSM program of $1.3 million (Kawamoto 1998).

In addition to the BOA, the Navy's ongoing energy efficiency efforts have earned more than $1.75 million in DSM rebates. Most of the rebates have been associated with Navy construction of 1,000 new family housing units. The homes incorporate 1,000 solar water heaters, 700 efficient split air conditioning units, 14,000 compact fluorescent lamps, and thousands of efficient T8 and high-intensity discharge lamps. The Navy earned the 1998 HECO Energy Award for energy efficiency for its the new Seawolf Tower Bachelor Enlisted Quarters (Munger 1999a, 23).

11.3 New Technologies for Energy Efficiency

11.3.1 Emerging Energy Efficiency Technologies Identified

In 1998, the American Council for an Energy-Efficient Economy examined more than 200 emerging energy efficiency technologies and practices that were defined as commercialized, but that had not achieved more than 2% market penetration or that would be "off-the-shelf" by 2005. Various screens for cost-effectiveness and potential savings were used to develop a list of 80 measures, which was then reduced to 33 high- and medium-priority technologies and practices (Nadel 1998).

11.3.2 RECOMMENDATION: Investigate New Measures and Practices for Building Energy Efficiency

Suggested Lead Organizations: DBEDT, the Utilities, Building Industry and Design Professionals

DBEDT further screened the list for applicability to Hawaii and selected six high priority measures and 12 medium priority measures for recommendation as part of this strategy. The high priority measures are, in order of energy savings potential:

1. Integrated commercial building design;

2. Integrated new home design;
3. Aerosol-based duct sealing;
4. Commissioning existing buildings;
5. Integrated lighting fixtures with controls; and
6. Improved ducts and fittings.

It should be noted that items 1, 2, and 4 are practices that DBEDT is already encouraging through its various energy efficiency programs. The remainder are technologies that have been commercialized and should be investigated for their technical potential in Hawaii. Medium-priority measures, in order of energy savings, included the following:

1. Improved fluorescent dimming ballast;
2. Commercial air distribution system (air duct) sealing;
3. One-lamp fixtures and task lighting;
4. Compact fluorescent floor and table lamps;
5. Advanced clothes washers and dishwasher controls;
6. Heat reflecting roof coatings;
7. High R (> 4 windows);
8. High-efficiency dishwashers;
9. Integrated space conditioning and water heating systems (heat pumps); and
10. Switched reluctance drives (high efficiency electric motors).

The reader is referred to *Emerging Energy-Saving Technologies and Practices for the Buildings Sector*, published by the American Council for an Energy-Efficient Economy for details on these measures (Nadel 1998).